

A Novel Approach of Microcontroller based Automatic Medication Reminder (AMR) System for Patients

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Abstract-This paper proposes a novel idea to provide the information automatically to patients to take their right dosages at appropriate time. Now a day, most of the patients may forget to take their medicines as per the prescription due to mental stress. Hence, it may cause prolong period to recover from the diseases. Sometimes, the aged patients are gulping tablets and their dosage level incorrectly causing a severe problem. Henceforth, it is necessary to the patient to take proper medicines at precise quantity and time. To overcome these problems, a novel Automatic Medication Reminder (AMR) system is proposed. This system uses a normal 4x4 matrix keypad, Microcontroller (Master IC & Slave IC), LCD display and Real Time Clock (RTC) module and an alarm system used to intimate the patients to take proper dosage at right time. The master microcontroller is interfaced with timer, LCD display and 4x4 matrix keypad used to store the details of the prescriptions of a particular patient. The Slave IC is used to engrass the instructions from Master IC and it would work as per the instructions. This portable and economical AMR system would help aged patients especially to the illiterate people.

Key words: *Arduino controller; RTC; Alarm System; LCD Display.*

I. INTRODUCTION

In-taking of proper dosage at proper time is a mandatory thing of every patient in the world. The patients may include children, students, businessman, aged persons etc. They are always very busy with their daily work schedule. If they would be suffering from any diseases or illness, then it is necessary to take their correct dosages efficiently, especially elder persons. Now a day, caring of old age is serious concern. Family members are the only responsible persons to help the patients. In this century, it is impossible to look after the elder persons' at all the time due to busy schedule for everyone. So the problems such as 1) In-taking of irregular medicine due to patient's busy schedule. 2) Complication in-taking large number of medicines at a time. 3) Adverse drug reactions caused by un-reconciled prescriptions obtained from different sources. 4) Lack of knowledge about

proper use of medicines. These above problems are arising to everyone due to nonadherence of medications. Then it is essential to take the appropriate medicines for their good health. As the cost of the in-home medical care upswings, every individuals search for a well-organized device to handle their medicines properly. Even though some medication reminders are available, they have complication in using by the older persons. In order to avoid these critical situations a novel Automatic Medication Reminder (AMR) system is proposed to help the patients to take their dosages effectively. Then one more noticeable advantage of this AMR system is an affordable cost and it is easy to handle by the elderly populations.

II. LITERATURE SURVEY

Kale Sapna, Bhadane, Ashwini, Pawar Pallavi, P.N.Achaliya ^[1], An Android based Medication Reminder System based on OCR using ANN. In this method, an Android based application is used for the patients. This application will remind their user to take correct medicines at appropriate time by setting the reminders in the mobile which is an automatic manner. These reminders will be spontaneously set by the application as per the prescription. This reminder will remind the patients to take medicine competently. This method will help only for young people who are having Android mobile. But for elder illiteracy people it is very difficult to operate and understand it. The device used in this system is costly and the process of creating the application in android mobile is tedious.

S.Mukund, N.K.Srinath ^[2], Design of Automatic Medication Dispenser. This method uses microcontroller interface with alphanumeric keypad, LED display, motor controller, multiple pill container and dispenser, alarm system. It is partially an automated device. The general procedure is to facilitate the user to set the timings to dispense multiple pills at required timings. Here the user is required to press a button to get the pill box and reset the

alarm button. In this method motor controller is used. So additionally 12V is required for providing supply to motor and it is suitable only for limited number of medicines. More chances are available to mishandle the device and it is not a portable device. Cost wise it is somewhat high.

Corey McCall, Branden Maynes, Cliff C. Zou, Ning J.Zhang^[3], An Automatic Medication Self-Management and Monitoring System for Independently Living Patients. This paper describes the development and evaluation of RMAIS (RFID-based Medication Adherence Intelligence System). This system provides an automatic operation for easy medication by using built-in scale for dosage measurement and a motorized rotation plate to bring the correct medicine container in front of patient. This prototype consists of five parts which includes a motorized rotation platform, scale, RFID reader, Microcontroller, user interface panel. The process used in this system is tedious and the RMAIS is an in-home device which is useful only when the patients are in home itself. It can support only up to seven medicines. The device would not be aware and it may introduce errors or wrong alarms until the tray is checked frequently. The scale used in this prototype is expensive and this RMAIS needs skilled persons to operate efficiently.

P.H. Tsai, C.Y. Yu, W.Y. Wang, J.K.Zao, H.C. Yeh, C.S. Shih, J.W.S. Liu^[4], Wedjat: A Mobile phone based medication reminder and monitor and iMAT: Intelligence Medication Administration Tools. This iMAT enables the pharmacist of each user to extract a machine readable medication schedule specifications (MSS) from the user's prescriptions. Once it is loaded into that iMAT schedule manager, then the tool automatically makes a medications timing which meets all restrictions indicated by the user's MSS. Based on the agenda, the tool intimate the user to take proper medicine in a proper quantity at proper time.

Zao J.K., Mei-Ying Wang, Peihuan Tsai, Liu J.W.S.^[5], Wedjat-Smart phone Application, This application is used to help the patients to avoid medication administration errors such as in-taking of wrong dosage instead of correct one, forgetfulness, etc. To avoid such critical situations, Wedjat can perform three functions: a) Issue medicine in-take reminders. b) Provide medicine identification and in-take directions. c) Keep the medicine in-take records.

III. PROPOSED METHOD

All human beings in the world may or may not affect by any of the diseases. Then all patients should take proper medicine which is specified in the prescription for their good health at proper time. Due to mental stress or depression, most of the times they forget to take proper medicines at proper time which leads to late recovery from diseases and it will create some problems in their normal health conditions. To overcome these problems, all patients' particularly elderly persons need medication reminder system. Even though some devices are available for reminding the patients to take medicines in automatic, somewhat they are not favorable to the users in the aspects of cost, portability, difficulties in handling etc. To make favorable to the user's the AMR system is proposed. Fig.1 shows the block diagram of proposed AMR system. This proposed prototype system consists of microcontroller (Master and Slave IC), 4x4 matrix keypad, LCD display, Real Time clock (RTC module) and

alarm system consists of buzzer. Then Light Emitting Diode (LED) is also provided to know the quantity of the dosages.

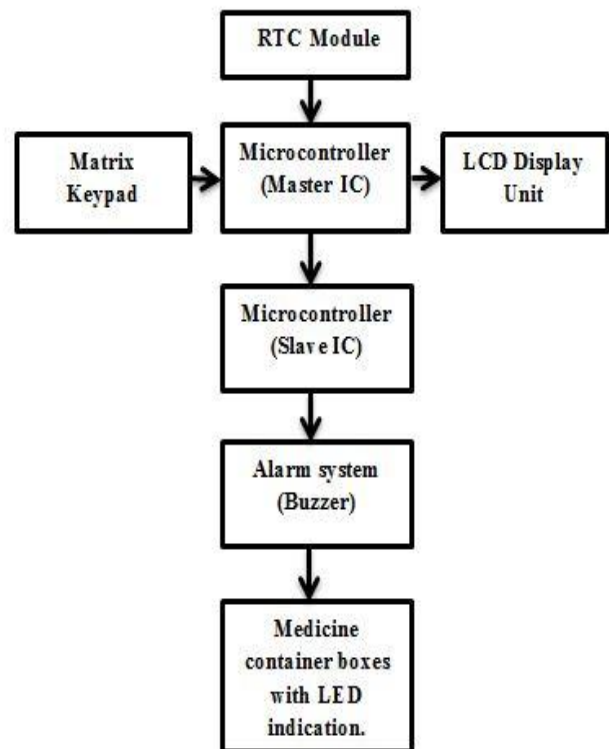


Fig 1: Block Diagram of AMR Prototype

Microcontroller is being responsible to perform all the commands and functions of the medicine container boxes in AMR system. Arduino controller of the system is capable to meet all the required functionalities without wasting money on unnecessary features and this system does not require any external peripheral devices and memory. The memory requirement is only 8K for both Master and Slave microcontroller. Initially the microcontroller (Master IC) interfaces with keypad and LCD display. Here there are three simple processes are required to be done in Master IC and their interfacing units. The process comprises 1) Enter the number of dosages. 2) Set the corresponding timings which are mentioned in prescription. 3) Set the current time. The dosages mentioned in the prescriptions are stored in Master IC and time setting operation can be done through the matrix keypad. After completion of these above processes, the Master IC is interfaced with that RTC module which is used to track the current time. This interfacing is done by connecting Serial Clock pin (SCL) and Serial Data pin (SDA) of RTC to the analog pins 5 and 4 of Master IC respectively. Here the number of medicines and time setting operations are changed frequently as per the prescription schedule given by doctor; but there should not be made any changes in current time. Once the user sets the current time then it always keeps on tracking current time with minutes and seconds. Now the number of medicines that would be taken by the patients and their corresponding timings are displayed to user through LCD display unit. Then buzzer and LEDs' which are placed above to each medicine containers interfaces with the Slave IC. After that the microcontroller (Slave IC) also interfaces with Master IC to receive the commands from it. The

interfacing between two microcontrollers is achieved by connecting transmitter (Tx) and receiver (Rx) pins of each other. Finally the Slave IC receives commands from Master IC when the setting time matches with current time. Based on the command received to Slave IC, it sends the input to buzzer and corresponding LED. Subsequently the LED lighting indications and beep sound will be provided. So obviously the alarm system gives information to the patients at appropriate time. If the set time does not match with current time then no commands will be received to Slave IC. Hence, the buzzer and LED will be off.

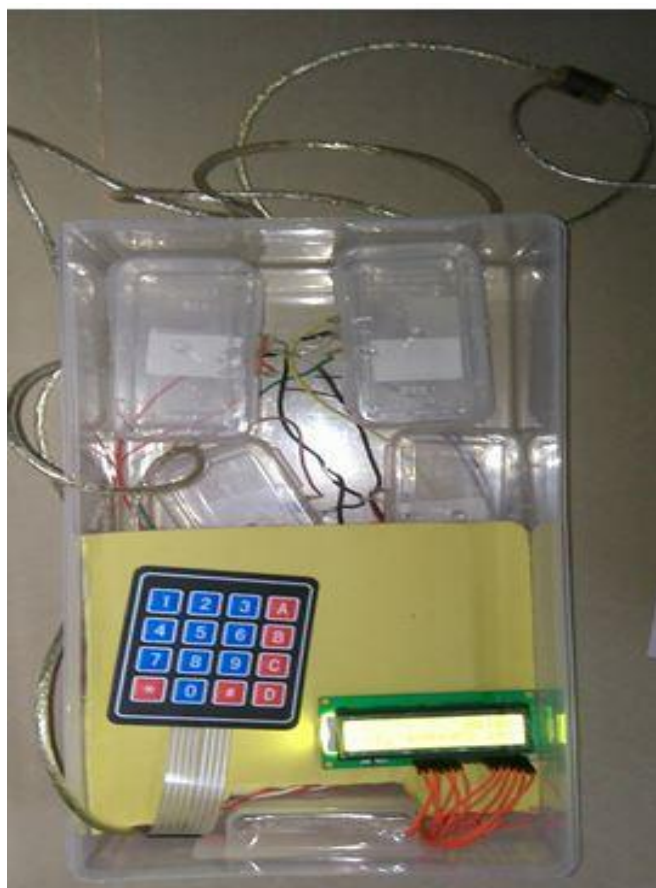


Fig 2: Prototype of Automatic Medication Reminder (AMR) System.

The Fig. 2 shows proposed AMR prototype system which can be handled easily by everyone. The patients' can have lot of welfares from this AMR prototype system as it avoids expensive in-home medical care. This system can support large number of medicines and it avoids confusion while taking more dosages by providing perfect LED indications on particular medicine container boxes. The color of LED indications are varied depends on the quantity of medicines which is mentioned in prescription. Then only the patient can easily find their medicines without any confusion. The only work of the patient is to take proper medicines when they receive the alarm buzzer sound. The process used in this system is simple and it is also portable one. The major drawbacks of existing methods are not economical and complication in handling by old age persons. Here the proposed system is less cost and it will easily be handled by elder persons also.

IV. EXPERIMENTAL ANALYSIS

The simplest experiment was made with Automatic Medication Reminder (AMR) system. In this technique, the proposed system is used to give information to patients automatically for taking proper dosage at accurate time which is mentioned in the prescription schedule. Initially the number of tablets or dosages and their time setting operations for entire prescription schedule can be entered by the doctor. Then the RTC module is also interfaced with Master IC to track the current time. For example if the patient needs to take three tablets at morning time (9.30 am) then the doctor has to enter the solution for the command "No. of Tablets" is 3. Then the doctor needs to answer for another command "set time" as 9.30 am. All the above details are done with the help of Master IC, keypad, LCD display. After that the controller (Master IC) is interfaced with RTC module to track the current time. All the three commands including Number of Tablets, Set time, Current time are displayed with the help of LCD display. Then the Slave IC receives the commands from Master IC when set time matches with current time. So that the LED indications and beep sound will be happened at corresponding medicine (tablet) container boxes. Similarly it can give the information for noon and night time also. Here the one and only work of patients is to take these medicines properly when they hear the beep sound and views LED lighting on the medicine containers. The Fig. 3 shows that there are two LEDs are provided on each boxes to indicate the quantity of dosages (Red color LED for full dosage and Blue color LED for half dosage) which would be taken by patients and buzzer sound is common for all dosages. The LED indication and buzzer sound will be ON until the patient press the 'RESET' button.



Fig 3: Prototype of Automatic Medication Reminder (AMR) System with LED Indications.

TABLE 1: Distinguish between Existing and Proposed Method.

| Problems in existing methodology | Solution in proposed methodology |
|--|---|
| RMAIS- RFID based Medication Adherence Intelligent System. In this system totally five expensive materials are used for system architecture and it is non portable. | In Automatic Medication Reminder (AMR) system totally five inexpensive equipment's are used and it a portable. |
| An Android based Medication Reminder System based on OCR using ANN. This system is completely based on android version. So it is not appropriately suitable for elder persons. | The Proposed AMR prototype consists of simple process. So it can be operated easily. Cost wise, it is more economical and efficient system. |

TABLE 2: Cost Estimation of AMR Prototype

| Materials | Cost (in Rupees) |
|---|------------------|
| Microcontroller – 8K (Master) | 250 |
| LCD display | 120 |
| Microcontroller – 8K (Slave) | 250 |
| 4x4 Matrix Keypad | 135 |
| Alarm system (Buzzer) | 30 |
| Medicine container box with LED indications | 235 |
| RTC Module | 200 |
| Total cost(in Rupees) | 1,220 |

V. ALGORITHM

1. Assign Variables for Number of Tablets.
2. Set the prescribed time.
3. If the set time matches with the current time, then the command from Master IC is sent to slave IC.
4. According to the command received to Slave IC, it sends input as 'HIGH' to the corresponding LEDs' and Buzzer.
5. Otherwise, there will be no command passed to Slave IC and hence no input will be sent to LED and buzzer.
6. The quantity of dosages will be indicated by using different colors of LEDs'.

VI. CONCLUSION

Currently, there are some medication reminder systems are available. But it has some difficulties such as complex process, expensive and not a portable one. The proposed Automatic Medication Reminder (AMR) system overcomes the drawbacks in the conventional system. This novel device has smaller in size, economical, better accuracy, compactness and less complexity in operation. The proposed system certainly would help all the aged patients especially to the illiterate people to take their medicines on time at the precise quantity. This system would also be a feasible solution for the elderly patients struggling in swallowing medicines as per the prescription given by the practitioner.

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BIOGRAPHIES



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